

**TISSUE PRODUCTS COMPRISING A MOISTURIZING
AND LUBRICATING COMPOSITION**

BACKGROUND OF THE INVENTION

[0001] This invention is directed to moisturizing and lubricating compositions which may be used in combination with tissue products such as bath and facial tissue. More particularly, this invention is directed towards moisturizing and lubricating compositions for use on one or both surfaces of a tissue product, which improve the level of comfort to the wearer and may provide a skin health benefit.

[0002] The stratum corneum is the outer-most layer of the skin and is responsible for regulating skin water levels and functioning as a barrier against chemicals and other stressors found in the environment. The complex arrangement of lipids in the intercellular space of the stratum corneum is responsible for the establishment of normal barrier function. Multi-layered structures of cholesterol, ceramides, and fatty acids, as well as some other minor lipids, provide the major barrier to the transport of hydrophilic substances into or through the skin. The link between the barrier function and skin health is apparent from the skin inflammation caused by lipid extraction from the skin.

[0003] Skin barrier can be damaged due to a number of mechanisms. One mechanism for damage is physical abrasion, which may be caused by repeated rubbing of tissue products, such as facial or bath tissue, on the skin. With physical abrasion, layers of the skin are stripped away causing damage to the stratum corneum. Also, biological fluids, such as urine, feces, nasal and vaginal secretions, may contain a variety of components that can damage the stratum corneum. Some specific examples include proteases, lipases, bile

acids, and fatty acids. Once the stratum corneum barrier is compromised, skin inflammation can occur.

[0004] Excessive hydration of the skin can also have a negative impact on skin barrier. The hydration level of diapered skin, for example, may reach between five and ten times that of undiapered skin. Frequent contact of diapered skin with fluids such as urine and feces may also contribute to increased hydration. Increased skin hydration disrupts skin lipid organization in the stratum corneum, and may increase the skin permeability of irritants, thus increasing the risk of skin inflammation.

[0005] Tissue products, such as bath and facial tissue, are commonly used to absorb body fluids and leave the skin dry. These products, in addition to absorbing and wiping fluids, however, also abrade the skin during use and frequently do not leave the skin completely dry and free of the body fluid after use. During frequent use of these products, the skin can become so dry and/or abraded as to appear red and be sore to the touch. To reduce this problem, additive formulations have been applied to tissue products to provide lubricity and moisture. Once deposited on the skin, these products may provide a skin benefit by occluding the skin and protecting the stratum corneum until the damage is repaired.

[0006] To date, the moisturizing and/or lubricating formulations applied to tissue products have not been completely satisfactory. Many formulations to date have proven to be unstable, even at slightly elevated temperatures and have tended to migrate into the product matrix prior to use where the formulation is only of minimal, if any benefit. Additionally, many formulations used to date have had very poor transfer rates from the product to the skin where it can be of use. As such, it is apparent that there is a commercial need for hydrophilic lubricating formulations

suitable for use in combination with tissue products, such as facial tissue and bath tissue. It would be advantageous if the lubricating formulation could provide a moisturization benefit to alleviate skin dryness, as well as present a soft, aesthetically pleasing feel to reduce friction between the product and skin. Also, it would be advantageous if the lubricating formulations were formulated to be fluid during processing and rapidly solidify after application to the products.

SUMMARY OF THE INVENTION

[0007] The present invention is generally directed to moisturizing and lubricating compositions for use in combination with tissue products such as facial and bath tissue. The moisturizing and lubricating compositions, which are hydrophilic, are introduced onto one or both surfaces of a tissue product. Upon use, the lubricating composition contacts the skin and is at least partially transferred onto the skin to improve skin health.

[0008] In one embodiment described herein, at least one surface of a tissue product comprises a hydrophilic composition, which is solid or semisolid at a temperature of about 30°C to about 80°C and comprises a humectant, an immobilizing agent, a compatibilizing agent, and an emollient. Optionally, the moisturizing and lubricating compositions of the present invention may comprise a skin barrier enhancing agent, such as sunflower oil or borage oil, and an antioxidant to stabilize the skin barrier enhancing agent. Additionally, a sterol or sterol derivative may be added to improve skin health.

[0009] The moisturizing and lubricating compositions of the present invention provide a reduction in the frictional discomfort and dryness associated with the use of tissue products.

[0010] The present invention is further directed to a tissue product comprising a tissue paper and a moisturizing and lubrication composition. The moisturizing and lubricating composition comprises from about 1% (by weight) to about 40% (by weight) of an emollient, from about 1% (by weight) to about 20% (by weight) of a humectant, from about 30% (by weight) to about 90% (by weight) an immobilizing agent, and from about 1% (by weight) to about 40% (by weight) of a compatibilizing agent. No more than about 50% (by weight) of the components of the moisturizing and lubricating composition are liquid at room temperature and no less than about 50% of the components are solid at room temperature. Also, at least about 85% (by weight) of the components of the moisturizing and lubricating composition form a single phase at a temperature of from about 45°C to about 80°C.

[0011] The present invention is further directed to a tissue product comprising a tissue paper and a moisturizing and lubrication composition. The moisturizing and lubricating composition comprises from about 1% (by weight) to about 40% (by weight) of a silicone, from about 1% (by weight) to about 20% (by weight) of a humectant, from about 30% (by weight) to about 90% (by weight) an immobilizing agent, from about 1% (by weight) to about 40% (by weight) of a compatibilizing agent and a dispersing agent. No more than about 50% (by weight) of the components of the moisturizing and lubricating composition are liquid at room temperature and no less than about 50% of the components are solid at room temperature. Also, at least about 85% (by weight) of the components of the moisturizing and lubricating composition form a single phase at a temperature of from about 45°C to about 80°C.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] Figure 1 is a graph of the water vapor transmission rates of various moisturizing and lubricating compositions of the present invention as described in Example 1.

[0013] Figure 2 is a graph of Percent Static Hygroscopicity of various moisturizing and lubricating compositions of the present invention as described in Example 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0014] In accordance with the present invention, it has been discovered that at least one surface of a tissue product can be treated with a moisturizing and lubricating composition to improve the overall performance of the tissue product. The moisturizing and lubricating composition comprises a humectant, an immobilizing agent, a compatibilizing agent, and an emollient, and optionally a dispersing agent.

[0015] The present invention is described herein in relation to a tissue product. The moisturizing and lubricating compositions are suitable for use on one or both surfaces of a tissue product, such as facial tissue, or bath tissue. Further, the moisturizing and lubricating compositions are suitable for use on disposable towels, napkin, hanks, and polyolefin wipers.

[0016] The tissue products of the present invention comprise a tissue substrate in combination with a moisturizing and lubricating formulation. As used herein, tissue products are meant to include facial tissue, bath tissue, towels, hanks, napkins and the like. The present invention is useful with tissue products and tissue paper in general, including but not limited to conventionally felt-pressed tissue paper; high bulk pattern densified tissue

paper; and high bulk, uncompacted tissue paper. The tissue paper can be of a homogenous or multi-layered construction, and tissue paper products made therefrom can be of a single-ply or multi-ply construction. The tissue paper desirably has a basis weight of between about 10 g/m² and about 65 g/m², and density of about 0.6 g/cc or less. More desirably, the basis weight will be about 40 g/m² or less and the density will be about 0.3 g/cc or less. Most desirably, the density will be between about 0.04 g/cc and about 0.2 g/cc. Unless otherwise specified, all amounts and weights relative to the paper are on a dry basis. Tensile strengths in the machine direction can be in the range of from about 100 to about 5,000 grams per inch of width. Tensile strengths in the cross-machine direction are in the range of from about 50 grams to about 2,500 grams per inch of width. Absorbency is typically from about 5 grams of water per gram of fiber to about 9 grams of water per gram of fiber.

[0017] Conventionally pressed tissue paper and methods for making such paper are well known in the art. Such paper is typically made by depositing a papermaking furnish on a foraminous forming wire, often referred to in the art as a Fourdrinier wire. Once the furnish is deposited on the forming wire, it is referred to as a web. The web is dewatered by pressing the web and drying at elevated temperature. The particular techniques and typical equipment for making webs according to the process just described are well known to those skilled in the art. In a typical process, a low consistency pulp furnish is provided from a pressurized headbox, which has an opening for delivering a thin deposit of pulp furnish onto the Fourdrinier wire to form a wet web. The web is then typically dewatered to a fiber consistency of between about 7% and about 25% (total web weight basis) by vacuum dewatering and further dried by pressing operations wherein the web is subjected to pressure

developed by opposing mechanical members, for example, cylindrical rolls. The dewatered web is then further pressed and dried by a steam drum apparatus known in the art as a Yankee dryer. Pressure can be developed at the Yankee dryer by mechanical means such as an opposing cylindrical drum pressing against the web. Multiple Yankee dryer drums can be employed, whereby additional pressing is optionally incurred between the drums. The formed sheets are considered to be compacted since the entire web is subjected to substantial mechanical compressional forces while the fibers are moist and are then dried while in a compressed state.

[0018] High bulk pattern densified tissue paper is characterized by having a relatively high bulk field of relatively low fiber density and an array of densified zones of relatively high fiber density. The high bulk field is alternatively characterized as a field of pillow regions. The densified zones are alternatively referred to as knuckle regions. The densified zones can be discretely spaced within the high bulk field or can be interconnected, either fully or partially, within the high bulk field. The patterns can be formed in a non-ornamental configuration or can be formed so as to provide an ornamental design(s) in the tissue paper. Preferred processes for making pattern densified tissue webs are disclosed in U.S. Pat. No. 3,301,746 (Sanford et al.), issued Jan. 31, 1967; U.S. Pat. No. 3,974,025 (Ayers), issued Aug. 10, 1976; and U.S. Pat. No. 4,191,609 (Trokhan) issued Mar. 4, 1980; and U.S. Pat. No. 4,637,859 (Trokhan) issued Jan. 20, 1987; all of which are incorporated by reference.

[0019] In general, pattern densified webs are preferably prepared by depositing a papermaking furnish on a foraminous forming wire such as a Fourdrinier wire to form a wet web and then juxtaposing the web against an array of supports. The web is pressed against the array of supports, thereby resulting in densified zones in the web at the

locations geographically corresponding to the points of contact between the array of supports and the wet web. The remainder of the web not compressed during this operation is referred to as the high bulk field. This high bulk field can be further de-densified by application of fluid pressure, such as with a vacuum type device or a blow-through dryer, or by mechanically pressing the web against the array of supports. The web is dewatered, and optionally predried, in such a manner so as to substantially avoid compression of the high bulk field. This is preferably accomplished by fluid pressure, such as with a vacuum type device or blow-through dryer, or alternately by mechanically pressing the web against an array of supports wherein the high bulk field is not compressed. The operations of dewatering, optional predrying and formation of the densified zones can be integrated or partially integrated to reduce the total number of processing steps performed. Subsequent to formation of the densified zones, dewatering, and optional predrying, the web is dried to completion, preferably still avoiding mechanical pressing. Preferably, from about 8% to about 55% of the tissue paper surface comprises densified knuckles having a relative density of at least 125% of the density of the high bulk field.

[0020] Desirably, the furnish is first formed into a wet web on a foraminous forming carrier, such as a Fourdrinier wire. The web is dewatered and transferred to an imprinting fabric. The furnish can alternately be initially deposited on a foraminous supporting carrier that also operates as an imprinting fabric. Once formed, the wet web is dewatered and, preferably, thermally pre-dried to a selected fiber consistency from about 40% to about 80%. Dewatering is preferably performed with suction boxes or other vacuum devices or with blow-through dryers. The knuckle imprint of the imprinting fabric is impressed in the

web as discussed above, prior to drying the web to completion. One method for accomplishing this is through application of mechanical pressure. This can be done, for example, by pressing a nip roll that supports the imprinting fabric against the face of a drying drum, such as a Yankee dryer, wherein the web is disposed between the nip roll and drying drum. Also, preferably, the web is molded against the imprinting fabric prior to completion of drying by application of fluid pressure with a vacuum device such as a suction box, or with a blow-through dryer. Fluid pressure can be applied to induce impression of densified zones during initial dewatering, in a separate, subsequent process stage, or a combination thereof.

[0021] Uncompacted, nonpattern-densified tissue paper structures are described in U.S. Pat. No. 3,812,000 (Salvucci et al.), issued May 21, 1974 and U.S. Pat. No. 4,208,459 (Becker et al.), issued Jun. 17, 1980, both of which are incorporated by reference. In general, uncompacted, nonpattern-densified tissue paper structures are prepared by depositing a papermaking furnish on a foraminous forming wire such as a Fourdrinier wire to form a wet web, draining the web and removing additional water without mechanical compression until the web has a fiber consistency of at least about 80%, and creping the web. Water is removed from the web by vacuum dewatering and thermal drying. The resulting structure is a soft but weak, high bulk sheet of relatively uncompacted fibers. Bonding material is preferably applied to portions of the web prior to creping.

[0022] Compacted non-pattern-densified tissue structures are commonly known in the art as conventional tissue structures. In general, compacted, non-pattern-densified tissue paper structures are prepared by depositing a papermaking furnish on a foraminous wire such as a Fourdrinier wire to form a wet web, draining the web and

removing additional water with the aid of a uniform mechanical compaction (pressing) until the web has a consistency of 25-50%, transferring the web to a thermal dryer such as a Yankee and creping the web. Overall, water is removed from the web by vacuum, mechanical pressing and thermal means. The resulting structure is strong and generally of singular density, but very low in bulk, absorbency and softness.

[0023] The papermaking fibers utilized in preparing tissue paper for the products of the present invention will normally include fibers derived from wood pulp. Other cellulosic fibrous pulp fibers, such as cotton linters, bagasse, etc., can be utilized and are intended to be within the scope of this invention. Synthetic fibers, such as rayon, polyethylene and polypropylene fibers, can also be utilized in combination with natural cellulosic fibers. One exemplary polyethylene fiber that can be utilized is Pulpex.RTM., available from Hercules, Inc. (Wilmington, Del.).

[0024] Applicable wood pulps include chemical pulps, such as Kraft, sulfite, and sulfate pulps, as well as mechanical pulps including, for example, groundwood, thermo-mechanical pulp and chemically modified thermo-mechanical pulp. Chemical pulps, however, are typically desirable since they impart a superior tactile sense of softness to tissue sheets made therefrom. Pulps derived from both deciduous trees and coniferous trees can be utilized. Also useful in the present invention are fibers derived from recycled paper, which can contain any or all of the above categories as well as other non-fibrous materials such as fillers and adhesives used to facilitate the original papermaking.

[0025] In addition to papermaking fibers, the papermaking furnish used to make tissue paper structures can have other components or materials added thereto as can be or

later become known in the art. The types of additives desirable will be dependent upon the particular end use of the issue sheet contemplated. For example, in products such as bath tissue, paper towels, facial tissues and other similar products, high wet strength is a desirable attribute. Thus, it is often desirable to add to the papermaking furnish chemical substances known in the art as "wet strength" additives.

[0026] In addition to wet strength additives, it can also be desirable to include in the papermaking fibers certain dry strength and lint control additives known in the art. In this regard, starch binders have been found to be particularly suitable. In addition to reducing tinting of the finished tissue paper product, low levels of starch binders also impart a modest improvement in the dry tensile strength without imparting stiffness that could result from the addition of high levels of starch. Typically, the starch binder is included in an amount such that it is retained at a level of from about 0.01 to about 2%, preferably from about 0.1 to about 1%, by weight of the dry tissue paper. The lubricating formulations described herein for use in combination with the tissue product are either solid or semi-solid at room temperature. As used herein, the term semi-solid means that the lubricating formulation has a rheology typical of pseudoplastic or plastic fluids. When applied to the tissue product, the lubricating formulations described herein impart a soft, lubricious, lotion-like feel to the touch. The lubricating formulation is transferred to the skin of the user upon use to improve the skin health of the user.

[0027] The tissue product includes a moisturizing and lubricating composition thereon. As noted above, the moisturizing and lubricating compositions of the present invention for use in combination with the tissue product

comprise a humectant, an immobilizing agent, a compatibilizing agent, and emollient, and optionally a dispersing agent.

[0028] The moisturizing and lubricating compositions of the present invention are preferably hydrophilic in nature; that is, the compositions are attracted to, and retain, water. It has been discovered that hydrophilic moisturizing and lubricating compositions for use on one or both surfaces of a tissue product typically introduce a higher level of moisture onto the skin or mucosal area, and retain the moisture in that area, as compared to hydrophobic compositions. As such, in accordance with the present invention, it is preferred that the moisturizing and lubricating compositions of the present invention be hydrophilic in nature.

[0029] One measurement of a composition's hydrophilicity is the composition's ability to dissolve or disperse in water. Typically, such dissolution/dispersion evaluations are done with heated water to improve the rate of dissolution/dispersion. The more soluble/dispersible a composition is in water, (typically compositions may be tested with water at a temperature of about 80°C as the formulations may be solid at room temperature) the more hydrophilic the composition. As such, it is preferred that the moisturizing and lubricating compositions of the present invention have a high degree of solubility/dispersibility in heated water.

[0030] More specifically, the lubricating and moisturizing compositions of the present invention are preferably at least about 40%, more preferably at least about 45%, more preferably at least about 60%, more preferably at least about 70%, and still more preferably at least about 80% soluble/dispersible in deionized water at a temperature of about 80°C. A preferred moisturizing and lubricating

composition of the present invention is about 80% soluble/dispersible in deionized water at a temperature of about 80°C. At these levels of solubility/dispersibility in 80°C deionized water, the moisturizing and lubricating compositions of the present invention are sufficiently hydrophilic to provide the intended benefits.

[0031] The lubricating and moisturizing compositions of the present invention desirably have a melting point of from about 30°C to about 80°C, more desirably from about 40°C to about 70°C, and still more desirably from about 55°C to about 75°C. With melting points in these ranges, the moisturizing and lubricating compositions of the present invention have a reduced tendency to flow easily and migrate into the interior of the product. This is important for at least two reasons. First, it is preferred that the majority of the moisturizing and lubricating composition remain on the surface of the product to allow direct interaction with the skin or mucous membrane it contacts. As such, a sufficiently high freezing temperature is desired such that the moisturizing and lubricating composition freezes, or solidifies, onto the substrate to which it is applied in a short amount of time to reduce the potential for run-off or migration. Therefore, it is preferred that the moisturizing and lubricating composition freeze onto the substrate in no more than about 3 seconds, desirably no more than about 0.25 seconds. With freezing rates in these ranges, the moisturizing and lubricating compositions of the present invention solidify quickly onto the substrate and the potential for migration is minimized.

[0032] Secondly, the melting point needs to be sufficiently high to provide sufficient stability for the composition. Stated another way, the melting points are desirably higher than the temperatures that the product to which the moisturizing and lubrication has been applied is

exposed to during storage and transport, which may be as high as about 55°C.

[0033] Additionally, the moisturizing and lubricating compositions of the present invention preferably have a penetration hardness (needle penetration in millimeters according to ASTM D 1321, "Needle Penetration of Petroleum Waxes") of from about 1 millimeter to about 200 millimeters, desirably from about 1 millimeter to about 120 millimeters, more desirably from about 1 millimeter to about 20 millimeters, and still more desirably from about 3 millimeters to about 17 millimeters. Penetration hardness of the moisturizing and lubricating compositions of the present invention may be important for two reasons. First, the softer the formulation (i.e., the higher the penetration hardness number) the more mobile the formulation will be, making the formulation more likely to migrate into the inner layers of the product. As such, it is typically desirable to have a penetration hardness of not more than about 50, desirably not more than about 20.

[0034] Second, very soft formulations tend to be more greasy/oily to the touch, which is typically not desirable on most tissue products. By requiring the moisturizing and lubricating compositions of the present invention to have a penetration hardness as described above, these compositions are less likely to migrate yet maintain a silky, creamy feeling on the surface of a tissue product.

[0035] The moisturizing and lubricating compositions of the present invention are preferably substantially non-irritating to the skin or mucous membrane to which they contact during use by the wearer; that is, it is preferred that the moisturizing and lubricating compositions not induce redness and/or swelling of the skin tissues when contacted with the skin of the wearer. Further, it is preferred that the moisturizing and lubricating compositions not interfere

with or hinder the natural ability of the skin and mucous membranes to repair themselves from injury due to, for example, wiping or other abrasive activity. As discussed below, some of the moisturizing and lubricating compositions of the present invention may contain a fat or oil and/or a sterol or sterol derivative to facilitate repair of the skin from such damage.

[0036] The moisturizing and lubricating compositions of the present invention comprise an emollient, a humectant, an immobilizing agent, a compatibilizing agent, and optionally a dispersing agent. Other optional components may also be included in the moisturizing and lubricating compositions described herein.

[0037] The moisturizing and lubricating compositions of the present invention comprise from about 1% (by weight) to about 40% (by weight) of an emollient. As used herein, the term "by weight" refers to the total weight of the moisturizing and lubricating composition. Thus, if a moisturizing and lubricating composition is 25% (by weight) emollients and has a total weight of 100 grams, the compositions comprises 25 grams of emollient. As used herein, an emollient refers to a compound that smoothes, softens, soothes, supples, coats, lubricates, moisturizes, protects and/or cleanses the skin and/or mucous membranes, such as labial walls, upon contact.

[0038] Emollients suitable for use in the moisturizing and lubricating compositions of the present invention include, but are not limited to, petroleum based emollients, fatty acids, fatty acids esters, vegetable oils, hydrogenated vegetable oils, alkyl ethoxylates, fatty alcohols and silicones such as dimethicone, dimethiconol, PEG dimethicone, alkyl silicones, phenyl silicones, and silicone phospholipids, and combinations thereof. Particularly

preferred silicone emollients include Dow Corning 200 Fluid and Dow Corning 1503 Fluid.

[0039] Suitable petroleum based emollients include those hydrocarbons, or mixtures of hydrocarbons, having chain lengths of from 16 to 32 carbon atoms. Petroleum based hydrocarbons having these chain lengths include mineral oil (also known as "liquid petrolatum") and petrolatum (also known as "mineral wax," petroleum jelly" and "mineral jelly"). Mineral oil usually refers to less viscous mixtures of hydrocarbons having from 16 to 20 carbon atoms. Petrolatum usually refers to more viscous mixtures of hydrocarbons having from 16 to 32 carbon atoms.

[0040] Suitable fatty acid ester emollients include those derived from C_{12} - C_{28} fatty acids, preferably C_{16} - C_{22} saturated fatty acids, and short chain, such as C_1 - C_8 , preferably C_1 - C_3 , monohydric alcohols. Examples include methyl palmitate, methyl stearate, isopropyl laurate, isopropyl myristate, butyl myristate, butyl stearate, octyl palmitate, isopropyl isostearate, isopropyl palmitate, ethylhexyl palmitate, and mixtures thereof. Suitable fatty acid ester emollients can also be derived from monoesters and diesters of both short chain, such as C_1 - C_{10} , and longer chain fatty alcohols, such as C_{12} - C_{28} , preferably C_{12} - C_{16} , and shorter chain organic acids such as lactic acid, lauryl lactate and cetyl lactate. Additional examples include diisopropyl sebacate, dimethyl sebacate, dioctyl sebacate, dibutyl sebacate, diisopropyl adipate, and dicapryl adipate. In addition, mixtures of petroleum based emollients and fatty acid ester emollients can provide emollient systems that have a superior feel compared to the pure components individually.

[0041] Suitable alkyl ethoxylate type emollients include C_{12} - C_{22} fatty alcohol ethoxylates having an average degree of ethoxylation of from about 2 to about 30. Preferably, the fatty alcohol ethoxylate emollient is

selected from the group of lauryl, cetyl, and stearyl ethoxylates, and mixtures thereof, having an average degree of ethoxylation ranging from about 2 to about 23.

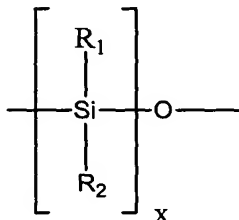
Representative examples of such alkyl ethoxylates include laureth-3 (a lauryl ethoxylate having an average degree of ethoxylation of 3), laureth-23 (a lauryl ethoxylate having an average degree of ethoxylation of 23), ceteth-10 (a cetyl alcohol ethoxylate having an average degree of ethoxylation of 10) steareth-10 (a stearyl alcohol ethoxylate having an average degree of ethoxylation of 10), and ceteareth-10 (a mixture of cetyl and stearyl ethoxylates having an average degree of ethoxylation of 10). Additionally, alkyl ethoxylates with an HLB of from about 7 to about 14 are also useful as emulsifiers or compatibilizers/solubilizers of other emollients in the composition.

[0042] Suitable fatty acid-type emollients include acids having a carbon chain length of C_{14} - C_{30} including myristic acid, palmitic acid, stearic acid, behenic acid, and mixtures thereof. Additionally, C_9 - C_{15} acids including caprylic acid, lauric acid, and the like are suitable fatty acid-type emollients.

[0043] Suitable fatty alcohol-type emollients include acids having a carbon chain length of C_{14} - C_{30} , including cetyl alcohol, stearyl alcohol, arachidyl alcohol, and behenyl alcohol and mixtures thereof. Additionally, C_9 - C_{15} alcohols including caprylic alcohol, cetearyl alcohol, coconut alcohol, decyl alcohol, hydrogenated tallow alcohol, lanolin alcohol, lauryl alcohol, myristyl alcohol, oleyl alcohol, palm alcohol, palm kernel alcohol, tallow alcohol, tridcyl alcohol and the like are suitable fatty alcohol-type emollients.

[0044] Another suitable type of emollient is a silicone such as a polysilioxane compound. Generally, suitable

polysiloxane materials for use include those having monomeric siloxane units having the following structure:



wherein x is a whole number from 1 to about 1,000,000 and R_1 and R_2 for each independent siloxane monomeric unit can each independently be hydrogen or any alkyl, aryl, alkenyl, alkaryl, arakyl, cycloalkyl, halogenated hydrocarbon, or other radical. Any of such radicals can be substituted or unsubstituted. R_1 and R_2 radicals of any particular monomeric unit may differ from the corresponding functionalities of the next adjoining monomeric unit. Additionally, the polysiloxane can be either a straight chain, a branched chain or have a cyclic structure. The radicals R_1 and R_2 can additionally independently be other silaceous functionalities such as, but not limited to siloxanes, polysiloxanes, silanes, and polysilanes. The radicals R_1 and R_2 may contain a variety of organic functionalities including, for example, alcohol, carboxylic acid, phenyl, and amine functionalities.

[0045] Exemplary radicals are methyl, ethyl, propyl, butyl, pentyl, hexyl, octyl, decyl, octadecyl, and the like. Exemplary alkenyl radicals are vinyl, allyl, and the like. Exemplary aryl radicals are phenyl, diphenyl, naphthyl, and the like. Exemplary alkaryl radicals are toyl, xylyl, ethylphenyl, and the like. Exemplary aralkyl radicals are benzyl, alphaphenylethyl, beta-phenylethyl, alpha-phenylbutyl, and the like. Exemplary cycloalkyl radicals are cyclobutyl, cyclopentyl, cyclohexyl, and the like. Exemplary

halogenated hydrocarbon radicals are chloromethyl, bromoethyl, tetrafluorethyl, fluorethyl, trifluorethyl, trifluorotoyl, hexafluoroxyl, and the like.

[0046] The viscosity of the useful polysiloxanes may vary widely. So long as the polysiloxane is flowable or can be made to be flowable for application, the polysiloxane viscosity is acceptable. This includes, but is not limited to, viscosity as low as 5 centistokes (at 37°C as measured by a glass viscometer) to about 20,000,000 centistokes (at 37°C as measured by a glass viscometer). A preferred range is from about 5 centistokes to about 5,000 centistokes. In one embodiment, a mixture of a low viscosity dimethicone (about 5 centistokes to about 350 centistokes) and a high viscosity dimethicone or dimethiconol or silicone gum (1,000,000 centistokes to about 20,000,000 centistokes) is preferred as the mixture produces a pleasant feeling material and provides additional lubricity. Preferred ranges of the low viscosity polysiloxane to high viscosity polysiloxane is from about 1:1 to about 10:1.

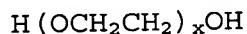
[0047] Preferred polysiloxane compounds for use as emollients in the present invention are disclosed in U.S. Patent No. 5,059,282 (Ampulski, et al.). Particularly preferred polysiloxane compounds for use as emollients in the moisturizing and lubricating compositions of the present invention include phenyl-functional polymethylsiloxane compounds (e.g., Dow Corning 556 Cosmetic-Grade Fluid) and cetyl or stearyl functionalized dimethicones such as Dow 2502, General Electric SF1632 and Dow 2503 polysiloxane fluids. In addition to such substitution with phenyl-functional or alkyl groups, effective substitution may be made with amino, carboxyl, hydroxyl, ether, polyether, aldehyde, ketone, amide, ester, and thiol groups. Phenyl, amino, alkyl, carboxyl, and hydroxyl groups are preferred, with phenyl functional groups being most preferred.

[0048] The humectant component of the moisturizing and lubricating compositions of the present invention are generally present in an amount of from about 1% (by weight) to about 20% (by weight), preferably from about 5% (by weight) to about 15% (by weight). Humectants are typically cosmetic ingredients used to increase the water content of the top layers of the skin or mucous membrane, by helping control the moisture exchange between the product, the skin, and the atmosphere. Humectants may include primarily hygroscopic materials. Suitable humectants for inclusion in the moisturizing and lubrication compositions of the present invention include urocanic acid, N-Acetyl ethanolamine, aloe vera gel, arginine PCA, chitosan PCA, copper PCA, Corn glycerides, dimethyl imidazolidinone, fructose, glucamine, glucose, glucose glutamate, glucuronic acid, glutamic acid, glycereth-7, glycereth-12, glycereth-20, glycereth-26, glycerin, honey, hydrogenated honey, hydrogenated starch hydrolysates, hydrolyzed corn starch, lactamide MEA, lactic acid, lactose lysine PCA, mannitol, methyl gluceth-10, methyl gluceth-20, PCA, PEG-2 lactamide, PEG-10 propylene glycol, polyamino acids, polysaccharides, polyamino sugar condensate, potassium PCA, propylene glycol, propylene glycol citrate, saccharide hydrolysate, saccharide isomerate, sodium aspartate, sodium lactate, sodium PCA, sorbitol, TEA-lactate, TEA-PCA, Urea, Xylitol, and the like and mixtures thereof. Preferred humectants include polyols, glycerine, ethoxylated glycerine, polyethylene glycols, hydrogenated starch hydrolysates, propylene glycol, silicone glycol and pyrrolidone carboxylic acid.

[0049] The immobilizing agent component of the moisturizing and lubricating compositions of the present invention are generally present in an amount of from about 30% (by weight) to about 90% (by weight), preferably from about 40% (by weight) to about 70% (by weight). The

immobilizing agent will reduce the tendency of the emollient and humectant to migrate or flow by keeping the emollient and humectant primarily localized. In addition to immobilizing the emollient and humectant, the immobilizing agent may provide a slight tackiness to the moisturizing and lubricating composition, which may improve transfer of the composition to skin or membrane of the wearer.

[0050] Suitable immobilizing agents for use with the moisturizing and lubricating compositions of the present invention include metal soaps such as aluminum stearate, calcium stearate, magnesium stearate, and zinc stearate, C_{14} - C_{22} fatty alcohols, C_{12} - C_{22} fatty acids, solid fatty acid esters, C_{12} - C_{22} fatty alcohol ethoxylates having an average degree of ethoxylation ranging from about 2 to about 30, and high molecular weight (greater than about 720) polyethylene glycols (a polymer of ethylene oxides) that are solids at room temperature having the following empirical formula:



wherein x is the degree of ethoxylation and is an average value of at least about 20 moles or greater. Preferably, x is an average value of from about 20 to about 1000, and even more preferably from about 100 to about 500. Particularly preferred high molecular weight polyethylene glycols are polyethylene glycols having the technical names of PEG 1000 (where x = 20), PEG 3350 (where x = 75), PEG 6000 (where x = 125), PEG 8000 (where x = 150), and PEG 10,000 (where x = 220).

[0051] Preferred fatty alcohol immobilizing agents include C_{16} - C_{18} fatty alcohols and fatty acids such as myristyl, cetearyl, cetyl, stearyl, behenyl, alcohols and acids and mixtures thereof. The preferred immobilizing agents increase the rate of crystallization of the emollient

causing the emollient to crystallize rapidly onto the bodyfacing surface of the interlabial pad.

[0052] Along with the emollient, humectant, and immobilizing agent, the moisturizing and lubricating compositions described herein comprise a compatibilizing agent. Compatibility of the overall moisturizing and lubricating composition is important for processability and stability. Incompatible compositions require a more rigorous process to ensure that mixing is complete so as to prevent the separation of the different components in the composition. More mixing requires higher energy consumption, which leads to an increase in the cost of manufacturing the products. Further, it may be very difficult for an incompatible composition to maintain acceptable stability during the life of the product, starting with shipping, transportation, and storage prior to ultimate use by the consumer. Many incompatible ingredients may tend to slowly separate from the surface of the product to which they are applied resulting in a loss of the properties of the overall composition and a potential loss in the intended benefits.

[0053] Some components described herein as components of the moisturizing and lubricating compositions of the present invention may be incompatible with a preferred humectant, glycerin. Specifically, it has been discovered that several immobilizing agents, including high molecular weight polyethylene glycols, are actually incompatible with glycerin. As such, in order to ensure a high degree of compatibility and a substantially homogeneous moisturizing and lubricating composition, the compositions described herein include a compatibilizing agent. For example, the compatibilizing agent is capable of compatibilizing glycerin and high molecular weight polyethylene glycols. The compatibilizing agent may be selected from propylene glycol, butylene glycol, 1,3 butylene glycol, low molecular weight

polyethylene glycols (molecular weights of less than about 720 and liquid at room temperature such as, for example, PEG 600), methoxyisopropanol, dipropylene glycol propyl ether, dipropylene glycol butyl ether, dipropylene glycol, methyl propanediol, and soluble/dispersible polypropylene glycols. The compatibilizing agent is present in the moisturizing and lubricating compositions of the present invention in an amount of from about 1% (by weight) to about 40% (by weight).

[0054] As mentioned above, the moisturizing and lubricating compositions described herein may optionally comprise a dispersing agent. Because some silicones, which may be introduced into the compositions as emollients as discussed above, may be incompatible with glycerin and some glycols, a dispersing agent may be added to improve the compatibility of silicones when they are introduced into the composition. Useful dispersing agents include polyether ethoxylated/propoxylated modified polydimethylsiloxanes which are fully or partially compatible with polydimethylsiloxanes, silicone polyethers having at least 30% siloxane, between 10% and 40% ethoxylation and between 0% and 40% propoxylation. For example, Dow Corning 5329 may be introduced as a dispersing agent to obtain the desired benefits. The weight ratio of silicone dispersing agent to silicone is preferably 3:1, more desirably 2:1, and even more desirably 1:1.

[0055] Although the liquid components of the moisturizing and lubricating compositions described herein are important as they provide plasticity and help to avoid a product that is too hard, brittle or flaky and thus uncomfortable, moisturizing and lubricating compositions that contain a high proportion of components that are liquid at room temperature are more difficult to process. Upon freezing, solid components, especially immobilizing agents, are important for providing a network that is capable of supporting the liquid components within it and, therefore,

preventing their migration through the substrate. When the solid portion of the moisturizing and lubricating composition is too small, the formed network may be overwhelmed by the large liquid portion making the solids unable to support the liquids in the network, which can then result in substantial migration by the liquid portions into the matrix of the fabric of the product.

[0056] In order to avoid this potential problem of having too high of a proportion of liquids, the moisturizing and lubricating compositions of the present invention comprise no more than about 50% components that are liquid at room temperature, and no less than about 50% of components that are solid at room temperature. Moisturizing and lubricating compositions that are comprised of such components provide a favorable balance of liquid and solid components, and allow for easy processability while maintaining good aesthetic attributes.

[0057] As noted throughout herein, compatibility is important in providing a moisturizing and lubricating composition that is easily processable and stable. As such, the moisturizing and lubricating compositions described herein possess high compatibility and have at least about 85% (by weight), desirably at least about 90% (by weight), more desirably at least about 94%, and still more desirably at least about 97% (by weight) of the components in a single phase at a temperature of from about 45°C to about 80°C. With such high compatibility, the moisturizing and lubrication compositions provide a significant advantage over prior compositions and are easily processable and stable. Additionally, it is preferable that the freezing point of the compositions be higher than room temperature to avoid the need for a cooling mechanism to process the compositions.

[0058] In addition to the emollient, humectant, immobilizing agent, and compatibilizing components described

herein, the moisturizing and lubricating compositions of the present invention may optionally include a skin barrier enhancing agent, such as a fat or oil (triglyceride/essential and non-essential fatty acid containing), to enhance the barrier function of the stratum corneum layer of the skin or mucous membrane. Skin and mucous membranes are comprised mainly of cholesterol, ceramides, and fatty acids. The addition of fats, oils, or triglycerides alone or in combination with sterols or sterol derivatives to the moisturizing and lubricating composition can refat/replenish or enhance the natural lipid barrier of the skin or mucous membranes that comes in contact with the product comprising the moisturizing and lubricating composition. In addition to reforming structures needed to provide the proper lipid structures in the skin, the natural fats and oils will not substantially negatively affect the natural skin barrier if repair is not necessary.

[0059] The skin barrier enhancing agent is typically from about 0.1% (by weight) to about 30% (by weight), more preferably from about 0.5% (by weight) to about 20% (by weight), and still more preferably from about 1% (by weight) to about 10% (by weight). Suitable fats or oils, or mixtures thereof, for inclusion in the moisturizing and lubricating compositions of the present invention typically comprise glycerides, triglycerides and/or essential and/or non-essential fatty acids. Suitable examples include apricot kernel oil, avocado oil, babassu oil, borage seed oil, butter, C₁₂-C₁₈ acid triglyceride, camellia oil, canola oil, caprylic/capric/lauric triglyceride, caprylic/capric/linoleic triglyceride, caprylic/capric/stearic triglyceride, caprylic/capric triglyceride, carrot oil, cashew nut oil, castor oil, cherry pit oil, chia oil, cocoa butter, coconut oil, cod liver oil, corn germ oil, corn oil, cottonseed oil, C₁₀-C₁₈ triglycerides, egg oil, epoxidized soybean oil,

evening primrose oil, glyceryl triacetyl hydroxystearate, glyceryl triacetyl ricinoleate, glycosphingolipids, grape seed oil, hazelnut oil, human placental lipids, hybrid safflower oil, hybrid sunflower seed oil, hydrogenated castor oil, hydrogenated castor oil laurate, hydrogenated coconut oil, hydrogenated cottonseed oil, hydrogenated C₁₂-C₁₈ triglycerides, hydrogenated fish oil, hydrogenated lard, hydrogenated menhaden oil, hydrogenated mink oil, hydrogenated orange roughy oil, hydrogenated palm kernel oil, hydrogenated palm oil, hydrogenated peanut oil, hydrogenated shark liver oil, hydrogenated soybean oil, hydrogenated tallow, hydrogenated vegetable oil, lard, lauric/palmitic/oleic triglyceride, lesquerella oil, linseed oil, macadamia nut oil, maleated soybean oil, meadowfoam seed oil, menhaden oil, mink oil, moringa oil, mortierella oil, neatsfoot oil, oleic/linoleic triglyceride, oleic/palmitic/lauric/myristic/linoleic triglyceride, oleostearine, olive husk oil, olive oil, omental lipids, orange roughy oil, palm kernel oil, palm oil, peach kernel oil, peanut oil, pengawar djambi oil, pentadesma butter, phospholipids, pistachio nut oil, placental lipids, rapeseed oil, rice bran oil, safflower oil, sesame oil, shark liver oil, shea butter, soybean oil, sphingolipids, sunflower seed oil, sweet almond oil, tall oil, tallow, tribehenin, tricaprin, tricaprylin, triheptanoin, trihydroxymethoxystearin, trihydroxystearin, triisononanoin, triisostearin, trilaurin, trilinolein, trilinolenin, trimyristin, trioctanoin, triolein, tripalmitin, trisebacin, tristearin, triundecanoin, vegetable oil, walnut oil, wheat bran lipids, wheat germ oil, and zadoary oil.

[0060] When the moisturizing and lubricating compositions of the present invention comprise a skin enhancing agent such as a fat or oil described above, it is highly preferred that the composition also comprise an

antioxidant. Compositions suitable for use on tissue products that contain a fat or oil skin enhancing agent without an antioxidant tend to develop an offensive odor making the product commercially unsuitable. This problem is especially acute when the products are exposed to elevated temperatures during processing, storage and shipping. It has been discovered that the offensive odor is attributable to the partial or complete oxidation of the fat or oil. As such, by introducing an antioxidant into the moisturizing and lubricating compositions of the present invention, the development of an offensive odor over time can be substantially minimized or eliminated resulting in a substantially improved commercial product.

[0061] In addition to minimizing or eliminating offensive odors which can be produced by natural fats or oils comprising the moisturizing and lubricating compositions of the present invention, the antioxidant may provide a skin health benefit by repairing damaged lipids on the skin's surface. The epidermal lipids consist of a high proportion of polyunsaturated fatty acids, which are susceptible to oxidation on the skin's surface. Oxidation of these polyunsaturated fatty acids can be initiated by a number of means including metals, such as iron, which are naturally present in the skin as well as in menstrual fluid. Antioxidants can prevent or repair oxidative damage to polyunsaturated fatty acids as well as other oxidation prone constituents in the skin.

[0062] The antioxidant is present in the moisturizing and lubricating compositions of the present invention in an amount of from about 0.05% (by weight) to about 5% (by weight), preferably from about 0.1% (by weight) to about 2% (by weight), and more preferably from about 0.1% (by weight) to about 1% (by weight). Antioxidants suitable for reducing the likelihood of the fats and/or oils to oxidize and produce

an unwanted odor include natural and synthetic tocopherol, butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), carotenoids, filtered wheat germ oil, gamma oryzanol, sodium sulfite, grape seed extract, green tea extract, rosmarinic acid, ubiquinone, lipoic acid, N-acetyl-cysteine, avocado, sage, and proanthocyanidins. Particularly preferred antioxidants include natural and synthetic tocopherol, BHT, and gamma oryzanol. Synthetic tocopherols include, for example tocopherol acetate, tocopherol linoleate, tocopherol succinate, tocopherol sorbate, tocotrienol, and Trolox (6-hydroxy-2, 5, 7, 8-tetramethyl chromane-2carboxylic acid).

[0063] The moisturizing and lubricating compositions of the present invention may also optionally include a sterol or sterol derivative or mixture of sterols and sterol derivatives to provide a skin health benefit. Typically, the moisturizing and lubricating compositions may include from about 0.1% (by weight) to about 10% (by weight), preferably from about 0.5% (by weight) to about 5% (by weight) and more preferably about 1% (by weight) of sterol or sterol derivative. Suitable sterols and sterol derivatives for incorporation into the moisturizing and lubricating compositions of the present invention include, for example, cholesterol sulfate, beta-sterols having a tail on the 17 position and having no polar groups, for example cholesterol, sitosterol, stigmasterol, and ergosterol, as well as C₁₀-C₃₀ cholesterol/lanosterol esters, cholecalciferol, cholesteryl hydroxystearate, cholesteryl isostearate, cholesteryl stearate, 7-dihydrocholesterol, dihydrocholesterol, dihydrocholesteryl octyldecanoate, dihydrolanosterol, dihydrolanosteryl octyldecanoate, ergocalciferol, tall oil sterol, soy sterol acetate, lanosterol, soy sterol, avocado sterols, cholesterol esters, sterol esters, and the like, as well as mixtures thereof.

[0064] The moisturizing and lubricating compositions of the present invention may also optionally include other components such as emulsifiers, surfactants, water, viscosity modifiers, pH modifiers, buffers, enzyme inhibitors/inactivators, suspending agents, natural moisturizing factors, pigments, dyes, colorants, perfumes, antibacterial actives, antifungal actives, pharmaceutical actives, film formers, deodorants, opacifiers, astringents, solvents, organic acids, coloring agents, preservatives, antiviral actives, drugs, vitamins, aloe vera, panthenol, and the like. These materials are known in the art and are used in their art-established manner at their art-established amounts.

[0065] The moisturizing and lubricating compositions of the present invention are introduced onto the desired product in an amount sufficient to provide a moisturizing and lubricating benefit. For example, the moisturizing and lubricating compositions of the present invention may be introduced onto one or both faces of a tissue product in an amount of from about 0.05 g/m² to about 100 g/m², more preferably from about 1.0 g/m² to about 40 g/m², and even more preferably from about 4 g/m² to about 15 g/m².

[0066] The present invention is illustrated by the following Examples, which are not meant to be limiting in any manner.

Example 1

[0067] In this Example, five moisturizing and lubricating formulations of the present invention were prepared and evaluated for various properties including water vapor transmission rate, static hygroscopicity, and stability. The components of each of the five formulations of the present invention, designated AB, AC, AG, AL, and AK are set forth in Tables 1-5 below:

Table 1 (AB):

Component	Weight Percent
Glycerin	10.0
PEG (600)	15.0
PEG (1000)	45.0
PEG (10,000)	25.0
Dow Corning 200 Fluid, 100 cst.	2.5
Dow Corning 1503 Fluid	2.5

Table 2 (AC):

Component	Weight Percent
Glycerin	10.0
PEG 600	20.0
PEG 1000	45.0
Stearic Acid	20.0
Dow Corning 200 Fluid, 100 cst.	2.5
Dow Corning 1503 Fluid	2.5

Table 3 (AG):

Component	Weight Percent
Glycerin	10.0
PEG 600	20.0
PEG 1000	30.0
Stearic Acid	20.0
Dow Corning 200 Fluid, 100 cst.	2.5
Dow Corning 5329	15.0
Dow Corning 1503 Fluid	2.5

Table 4 (AK):

Component	Weight Percent
PEG 600	15.0
PEG 1000	20.0
PEG 3350	25.0
PEG 10,000	25.0
Dow Corning 200 Fluid, 100 cst.	2.5
Dow Corning 1503 Fluid	2.5
Glycerin	10.0

Table 5 (AL):

Component	Weight Percent
Glycerin	10.0
PEG 600	15.0
PEG 1000	45.0
PEG 10,000	20.0
Stearic Acid	5.0
Dow Corning 200 Fluid, 100 cst.	2.5
Dow Corning 1503 Fluid	2.5

[0068] The water vapor transmission rate of the various formulations was measured to evaluate the barrier properties of the various formulations toward the permeation of water vapor. The formulations were measured by melting each formulation and manually applying the melted formulation to a collagen film using a finger cot at a level of about 2 microliters/cm². The coated collagen film was mounted onto a stainless steel permeability cup partially filled with deionized water. A gasket and a washer were placed on top of the collagen film and secured in place using metal clamps. The entire assemblage was then weighed at time zero, and then successively after 1, 2, 3, and 4 hours. The data was used to determine water vapor transmission rate through both coated and uncoated (control) films. The water vapor transmission rate was calculated from the slope of the cumulative weight loss versus time and expressed as weight loss per unit area per unit time (g/m²/h). All measurements were taken in a controlled environment (24°C and 45% relative humidity). Each formulation was run in five replicates and the average water vapor transmission rate was calculated.

[0069] The results of the water vapor transmission tests are shown in Figure 1. The data show that all of the formulations are generally highly permeable to water vapor,

which means that each formulation will allow water to pass through it relatively easily.

[0070] Static hygroscopicity measurements were made to evaluate the ability of the formulations to absorb and hold water by quantifying the amount of water picked up from a humidified atmosphere. Each formulation was melted and applied to a preheated glass slide of known weight. Another heated glass slide was used to spread the formulation across the first slide and then the first slide weighted again to determine the amount of formulation applied. The slide was then placed for 24 hours on a rack within a humidification chamber (10% glycerin in water, relative humidity about 100%). At the conclusion of the incubation period, the slide was removed and immediately weighed. The amount of water absorbed was expressed as percentage weight of the original formulation (percent increase in sample weight). An uncoated glass slide was used as the control. Each formulation was run in five replicates and the average was calculated.

[0071] The results of the static hygroscopicity tests are shown in Figure 2. All formulations tested showed high hygroscopicity as evidenced by more than doubling their weight in the humidified chamber.

[0072] The stability of each formulation was measured to determine what percentage of the formulation remained in a single homogeneous phase over a period of time at an elevated temperature. Each formulation was prepared, heated to melt the formulation, introduced into a 150 mL separation funnel, and stored overnight at 70°C to determine how much formulation remained in a single phase. The following day, any phases present in the separation funnel were separated into different beakers and weighed. It was found that all of the formulations had at least about 95% (by weight) in a single phase with the exception of formulation AG, which had at least about 97% (by weight) in a single phase.

[0073] Without being bound to a particular theory, it is believed that the silicones present in the formulations described herein are the only components that may have a tendency to quickly separate out from the bulk of the formulation. Although this may not occur with every formulation, it has been discovered that the addition of a dispersing agent, such as Dow Corning 5329, can substantially reduce the amount of silicones that separate out from the formulation. As such, it is believed that formulation AG had a higher amount of components (by weight) in a single phase due to the presence of a dispersing agent in the formulation.

[0074] In view of the above, it will be seen that the several objects of the invention are achieved. As various changes could be made in the above-described products and methods without departing from the scope of the invention, it is intended that all matter contained in the above description be interpreted as illustrative and not in a limiting sense.